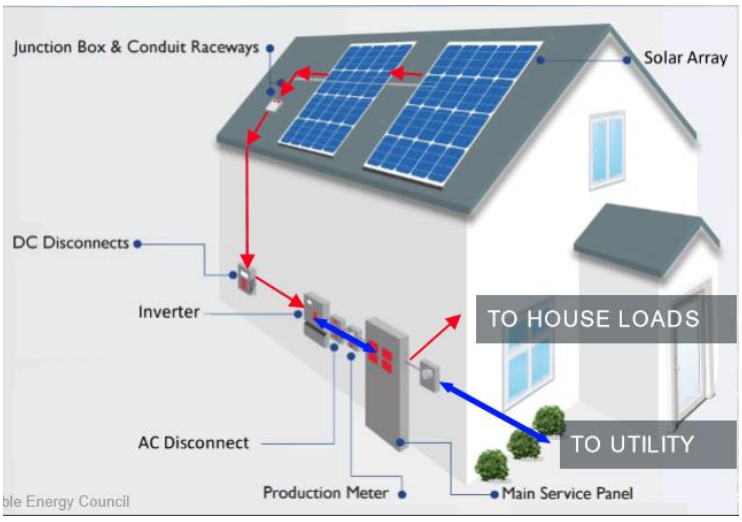
Solar Panels

(*Grid Tied Systems*)

Examples of Photovoltaic systems (P.V. systems) i.e. solar panels. Solar energy systems are systems that are designed to harness solar energy to generate thermal and/or electrical energy through the use of photovoltaic panels and associated components.

EXAMPLE OF GRID-TIED SYSTEM (Connected directly to utility grid, no battery storage)



Photovoltaic systems (PV) or "Solar Panel systems are designed for many functions such as:
1). To provide space heating and/or cooling;
2). To provide hot water heating;
3). To provide swimming pool heating

The code has several requirements for each type of use. This handout is intended to provide some general guidelines.

NOTE: This system is designed to reduce the amount of power required from the utility. Depending on the size of the system the amount of power generated may exceed that of the power demand. When this happens the system will be exporting electricity back to the utility grid. Please contact your utility provider for any questions regarding compensation or benefits that may be provided. The following are links for assistance

Mid American Energy – https://www.midamericanenergy.com/private-generation.aspx

Consumers Energy - https://new.consumersenergy.com/residential/renewable-energy

This system will not generate power[1] during a power outage unless the system includes a battery backup. Photovoltaic systems will shut off during grid power outages as a safety feature so as not to energize utility electric line that are assumed to be non-energized by utility staff.

[1]Even though the system is shut down the panels and their leads (typically 18" in length) have the potential of being energized.

Photovoltaic systems can be designed with a battery backup (UPS system) to operate selected circuits in a building for hours or days during a utility outage. Circuits such as furnace, refrigerator, and/or a general use circuit.

SUBMITTAL REQUIREMENTS

Overview of permit submittal documents

1. Permit application
2. Site plan if panels are not installed on an existing structure
3. Roof system layout plan (site plan not required if system on roof)
4. Structural Engineering documents if on structure
5. Technical Data Sheets of panels, modules, inverter and rack system
6. Electrical schematic plan to include size of wires, types of wires, disconnects, etc.
7. Interconnectivity agreement with electrical utility company (see above website links)
8. Signage requirements

1. Permit Application

An Electrical permit application is required to be submitted along with submittal documents.

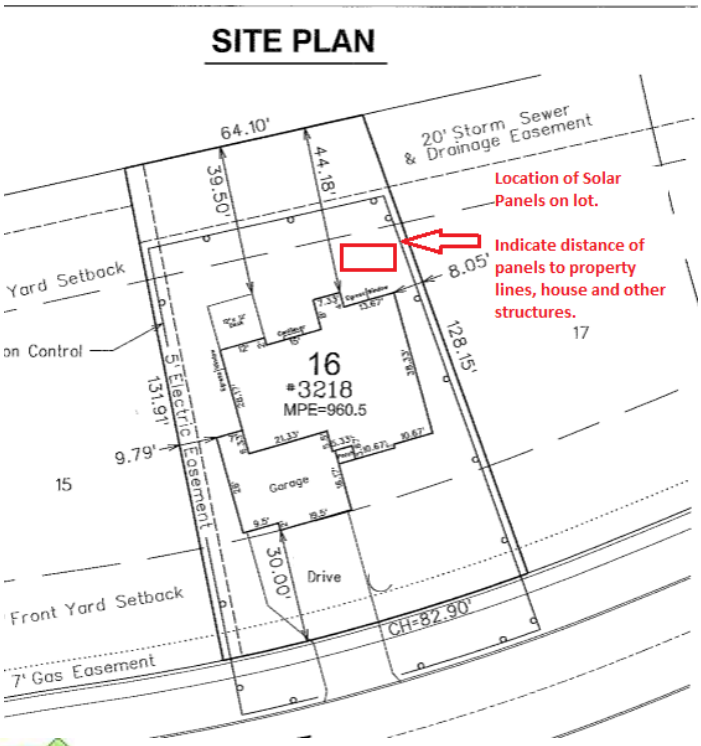
A Building permit is required to be submitted if structural changes are needed. The permit application required is for Additions & Alterations (Residential) and can be found at:

http://www.ankenyiowa.gov/departments/planning-and-building/building-information/permit-applications-guidelines

Applications may also be obtained from the following:
Public Safety Building
222 W. 1st Street
Ankeny, Iowa 50023

Staff can also be reached at 515-963-3550

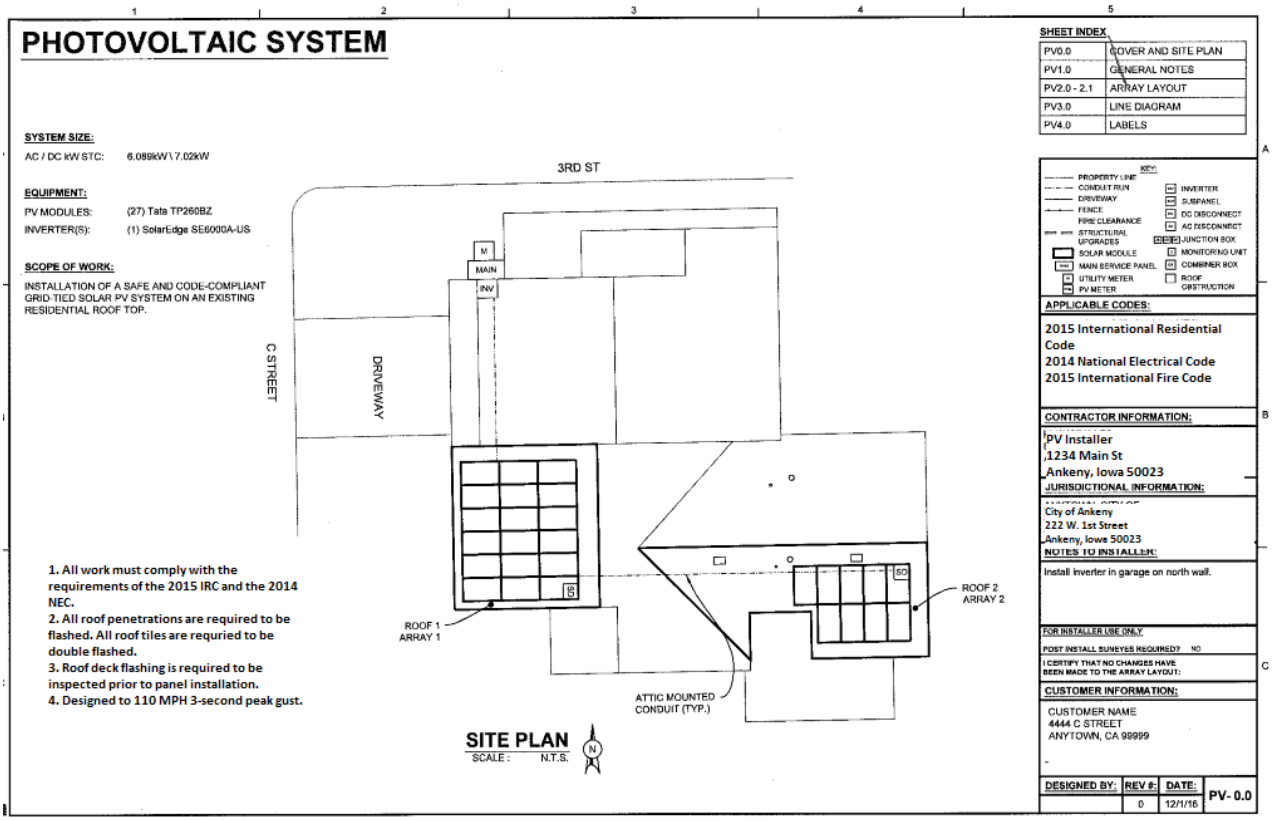
2. Site plan if panels are not installed on an existing structure



Panels located in a yard are treated as “Accessory” structures for Zoning Code purposes.

This means the panels must be:
1) In the rear yard
2) Not located in any easements
3). Be 3 feet from a property line
4). Cannot exceed 12 feet in height
5). If on corner lot must conform to the front yard setback regulations on both streets.

3. Roof system layout plan

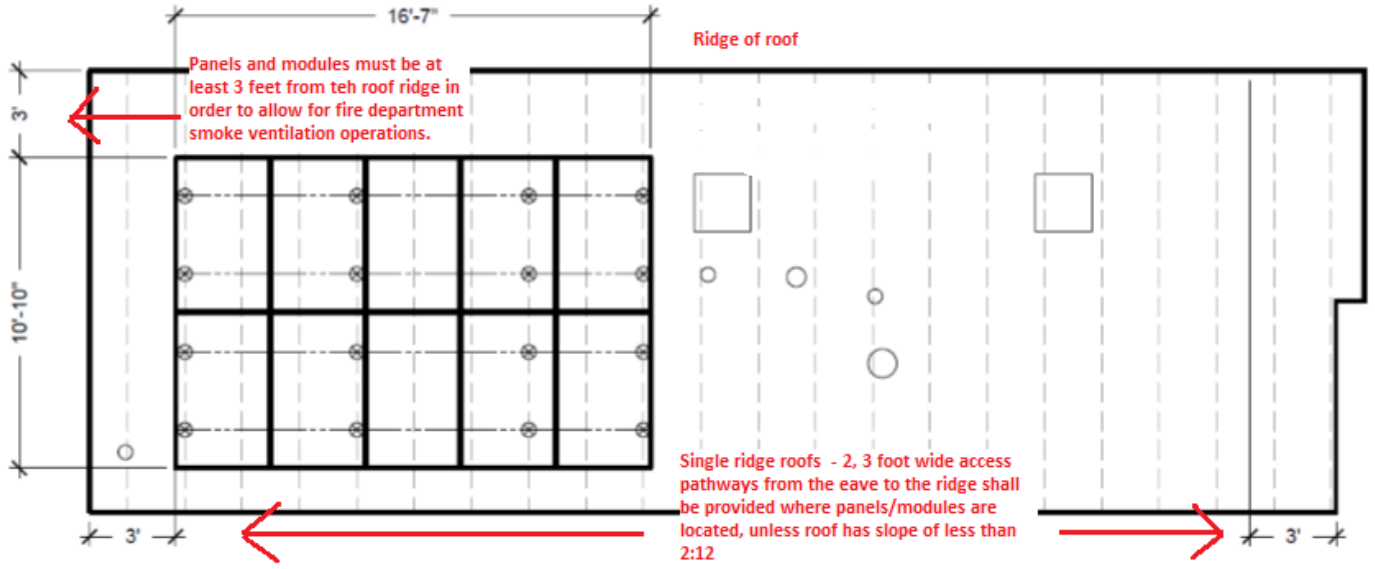


Example of Roof system layout

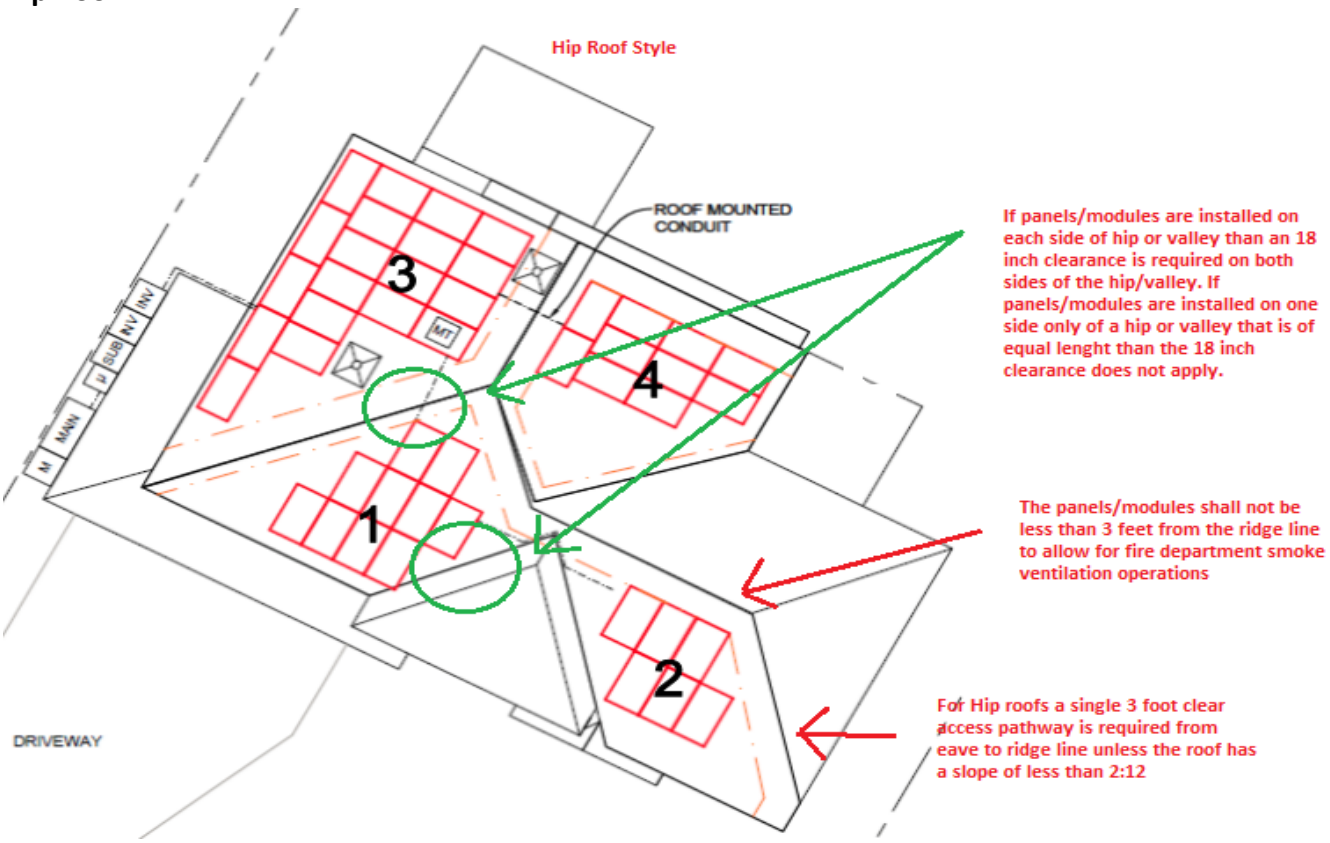
The roof system layout needs to provide the following items:

A. The location of the solar panels on the actual roof as well as junction boxes and rapid shutdown.
B. Location of any chimneys, plumbing vents, attic ventilation, peaks, valleys and ridge lines.
C. Location of Inverter, a/c disconnect, combiner box, dc disconnect, main power disconnect, etc.
D. Type of roof materials, location of DC or AC wiring (also noting if surface mounted or other method)
E. Access pathways as required by the IRC (see the following).

Single Ridge Roof



Hip Roof



NOTE: 1. Each photovoltaic array is limited to 150 feet by 150 feet. Multiple arrays shall be separated by a clear access pathway not less than 3 feet in width.

2. Roof access points shall be located in areas that do not require the placement of ground ladders over openings such as windows or doors, located at strong points of building construction and where the access point does not conflict with overhead obstructions such as tree limbs, wires and signs.

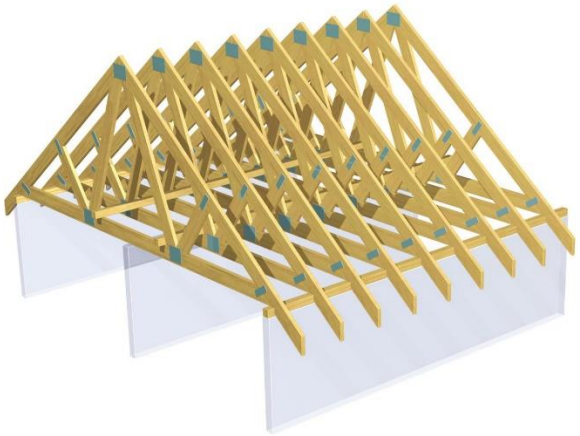
3. Detached garages and accessory structures to one & two family dwellings are exempt from the access pathway requirements.

4. Structural Engineering

NOTE: A structural engineers report is required to be submitted with the permit application. The existing roof system is required to be analyzed by a licensed professional in order to determine whether or not the existing structure is capable of supporting the increased loads from the solar panel system.

Residential applications typically involve a pitched roof in which solar panels are mounted parallel to the roof pitch. The gravity loads of the solar panels can magnify the uniform loads existing on the roof by concentrating them as point loads. The same holds true for wind loading, as the wind uplift is accumulated through the solar array and directed to the posts that support the solar panel. Also, depending on the roof geometry, the solar panel may act as a sail and catch wind from under the panel, creating very high uplift loads. In some applications, solar panels are put on flat roofs. To achieve higher efficiency, the photovoltaic panels will be posted to the roof such that the panels are at a pitch angled toward the sun. With this geometry, snow can accumulate on the solar array, but can also slide off the panel and create a drift on the low side of the panel. Further, wind can create many different loading scenarios in roof applications.

Yet another concern is that solar panels are often attached to rafters or trusses with lag screws that must land in the center of a 1.5-inch-wide top chord. Depending on the diameter of the connector, a repair may be required due to the section loss of the wood in the top chord. It is highly recommended that all connections of solar panels be made into blocking that is run between trusses, thus avoiding potential damage to the structural integrity of the truss or rafter. This not only prevents the drilling of trusses, but also distributes any point loads between two trusses and decreases the severity of any repairs.

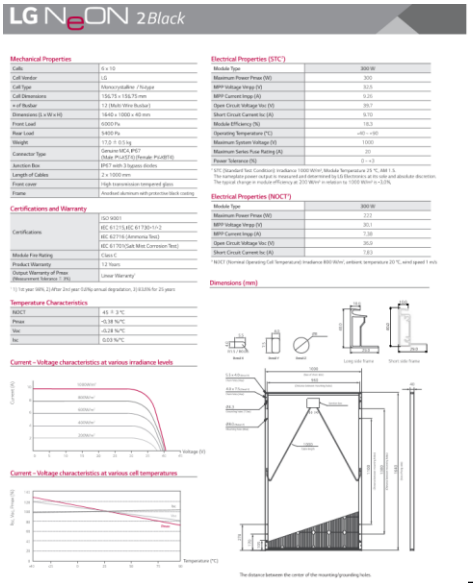


Different types of roof structural systems play a key in how they perform. For instance trusses are different than stick build or I-joists.

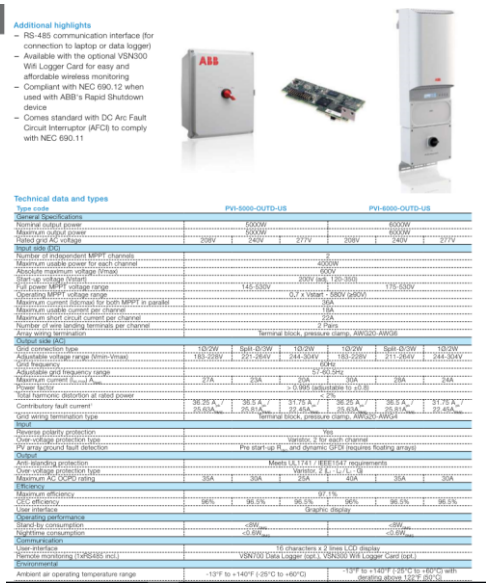
Other factors that may need to be taken into account is the number of shingle layers on the roof or the weight of the solar arrays, etc.

2015 IRC Section 802.10.4 states *"… Alterations resulting in the addition of load such as HVAC equipment water heater that exceeds the design for the truss shall not be permitted without verification that the truss is capable of supporting additional loading."*

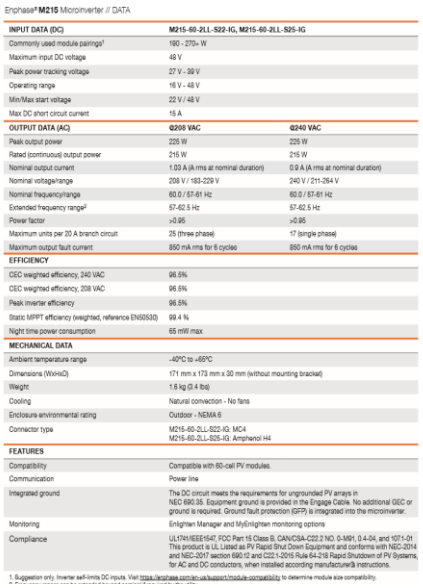
5. Technical Data Sheets of Panels, Modules, Inverter and Rack system



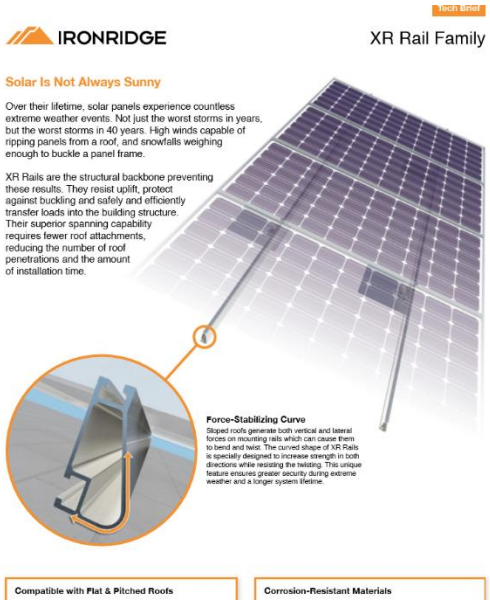
Ex: Solar Panel



Ex: Inverter



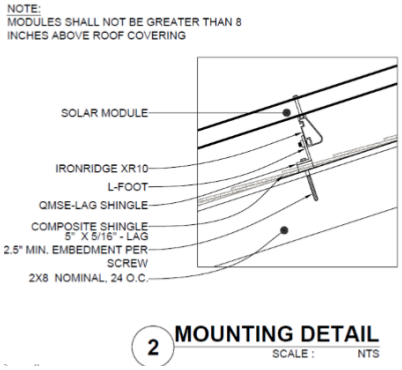
Ex: Micro Inverter/Power Optimizer



Ex: Rail System

NOTES:

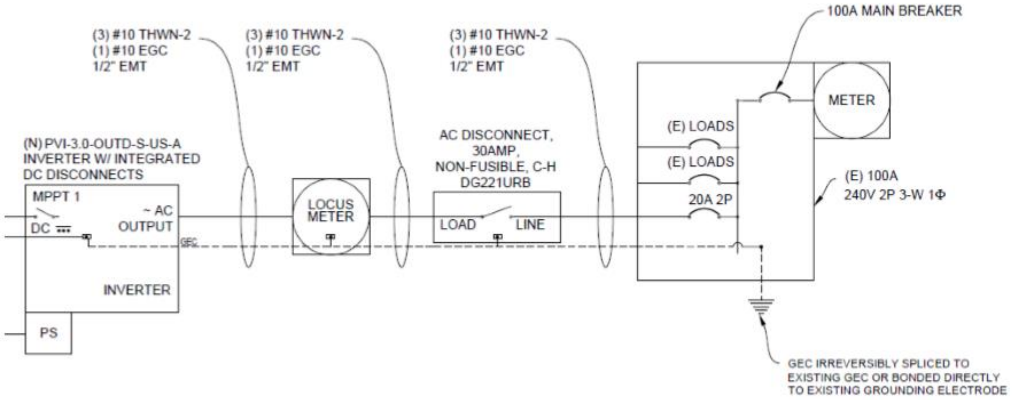
1. Rooftop mounted panels/modules shall be tested, listed and identified with a fire classification in accordance with UL 1703.
2. Roof penetrations shall be flashed and sealed per IRC chapter 9.
3. Manufactures roof rail system is required to be provided along with inverters, panel arrays and power optimizer/micro inverter information.
4. Mounting installation guidelines are required to be provided



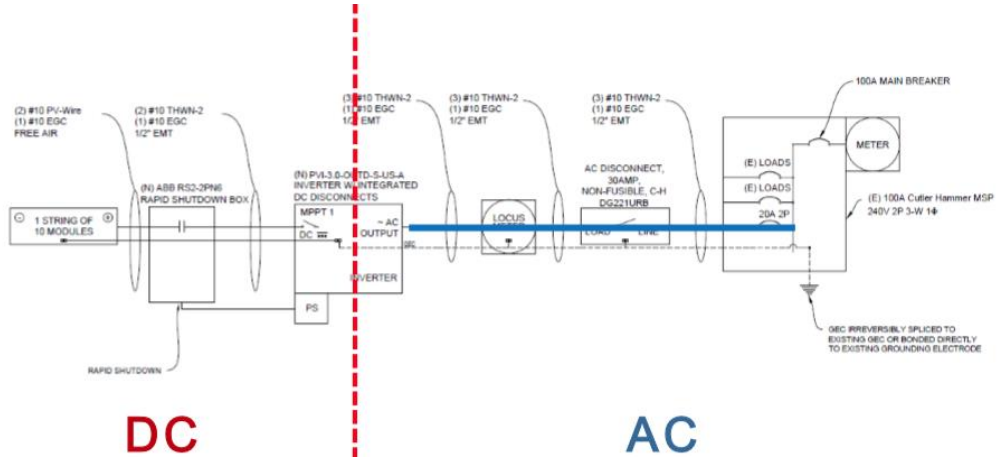
Ex: Mounting detail

6. Electrical schematic plan to include size of wires, disconnect, types of wires, list of all equipment and components and manufacturers cut sheets of equipment/compenents.

A State of Iowa Licensed Electrician is required to obtain the electrical permit and perform the installation. The information provided does not reflect all code related items or requirements. The following is just a generic example with some key notes.



Example of Line diagram



Example of Line diagram

USE-2 Wire is allowed to be used however if the inverter is a transformerless inverter than <u>PV wire must be used</u>

GENERIC BASIC NOTES:

1. The modules and rack are required to be bonded. Two methods are allowed:
   A. Use the rack to ground/bond the modules
   B. Use an Equipment grounding conductor to ground/bond the modules
2. The module/rack assembly must be listed for bonding per UL 2703, if using method A
3. The equipment grounding conductor being used is connected to the modules/rack per the manufacturer's installation instructions.
4. If racking system does not meet UL 2703 then each splice is required to be bonded together.
5. If racking system is not used for bonding purposes then each module must be bonded via an Equipment Grounding Conductor or other approved method.
6. Grounding Electrode Conductor must be irreversibly spliced to existing grounding electrode conductor or bonded directly to existing grounding electrode from the Invertor to the main disconnect.

7. Interconnectivity agreement with utility company

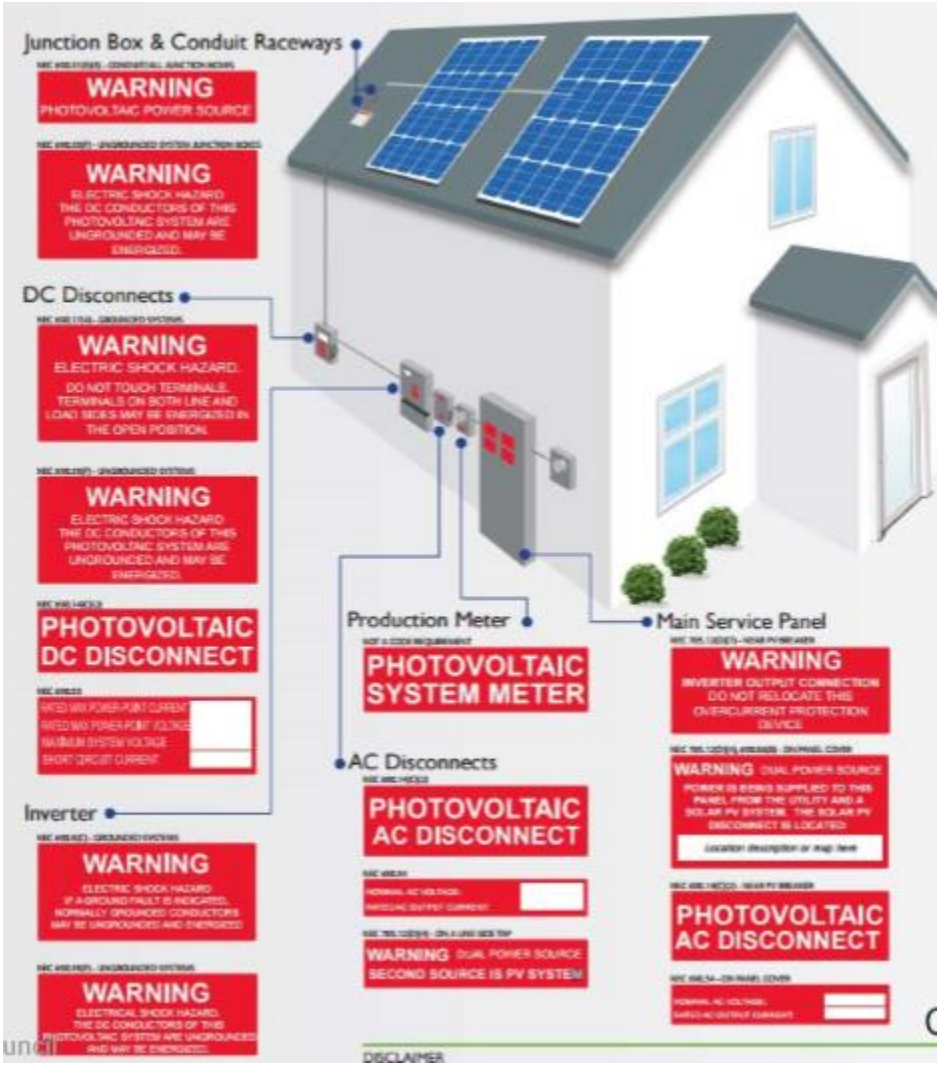
A copy of the connectivity agreement between the utility company and the property owner is required to be provided at the time of permit submittal.

Information and contact information regarding the agreements can be found at:

Mid American Energy – https://www.midamericanenergy.com/private-generation.aspx

Consumers Energy - https://new.consumersenergy.com/residential/renewable-energy

8. Signage requirements



Signage is required to be installed at:

1. Junction boxes
2. Conduit raceways
3. DC disconnects
4. Inverter
5. AC disconnects
6. Main Service panel
7. Production meter

Please refer to NEC Articles 690 & 705 for signage requirements

This handout is to serve as a guide to what the basic requirements are for PV systems. This handout does not cover all code related items. Each structure is reviewed separately and may require additional items depending on site and structure conditions.